# Managerial Applications of System Dynamics

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<sup>\*</sup>Originally published by Wright-Allen Press and now distributed by The MIT Press.

## Managerial Applications of System Dynamics

Edward B. Roberts, editor

The MIT Press Cambridge, Massachusetts, and London, England 658.4 146.665 4.0

Library of Congress Cataloging in Publication Data

Roberts, Edward Baer.

Managerial applications of system dynamics.

(MIT Press/Wright-Allen series in system dynamics)
Bibliography: p.
Includes index.
1. Industrial management — Addresses, essays,
lectures. I. Title.

HD31.R567 658.4 77-26952
ISBN 0-262-18088-X

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### Other Books by Edward B. Roberts

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The Persistent Poppy: A Computer-Aided Search for Heroin Policy (with G. Levin and G. Hirsch). Cambridge: Ballinger Publishing Company, 1975.

The Dynamics of Human Service Delivery (with G. Levin et al.). Cambridge: Ballinger Publishing Company, 1976.

Sist

### Contents

Prefa	ce owledgments		xi ::
	_		xiii
Part (	One System Dynamics — Basic Concepts System Dynamics — An Introduction Edward B. Roberts		3
2	Industrial Dynamics — A Major Breakthrough for Decision Makers  Jay W. Forrester	. /	37
3	Industrial Dynamics and the Honeywell Experience R. J. Meyers and A. R. Roberts		67
4	Strategies for Effective Implementation of Complex Corporate Models  Edward B. Roberts		77
Part 7	Two System Dynamics in Manufacturing		87
5	On the Application of Servomechanism Theory in the Study of Production Control Herbert A. Simon		95
6	An Industrial Dynamics Case Study Willard R. Fey		117
7	An Industrialist Views Industrial Dynamics  Bruce R. Carlson		139
8	How Managers Use Industrial Dynamics Kenneth J. Schlager		145
« 9	Some Insights into Implementation  Edward B. Roberts		155
10	Systems Analysis of Workload Fluctuations: A Case Study of the Precision Company  Edward B. Roberts		163
			vii

Par	t Three The Dynamics of Marketing and Distribution	185
• 1	Advertising: A Problem in Industrial Dynamics  Jay W. Forrester	191
÷ 12		205
13	Systems Analysis of Apparel Company Problems  Edward B. Roberts	227
14	Growth Strategies for a Trucking Firm  Richard D. Wright	245
15	The United States Plywood Industry: A Systems Study Thomas J. Manetsch	261
Part	Four Research and Development System Dynamics	270
16	Research and Development Policy Making  Edward B. Roberts	<b>279</b> 283
17	A Simple Model of R&D Project Dynamics Edward B. Roberts	293
18	The Problem of Aging Organizations  Edward B. Roberts	315
19	The Dynamics of R&D Strategy Henry B. Weil, Thomas B. Bergan, and Edward B. Roberts	325
20	Modelling Strategies for Corporate Growth  Robert S. Spencer	341
21	The Use of Dynamic Modeling for Conditional Forecasts of Resource Allocation Policies  A. Wade Blackman	355
22	Exploratory and Normative Technological Forecasting: A Critical Appraisal Edward B. Roberts	373
art 1	Five Management Control and Financial Applications	
23	Design of Management Control Systems  Edward B. Roberts	<b>389</b> 393
24	Design of Resource Control and Marketing Policies Carl V. Swanson	413
25	Policy Formulation in a Vertically-Integrated Firm Edward B. Roberts, Dan I. Abrams, and Henry B. Weil	427
26	Organizational Change: An Industrial Dynamics Approach L. Fillmore McPherson III	447
27	Industrial Dynamics and Management Information Systems Henry B. Weil	461

		Contents	ix
28	A Banker's Appreciation of Systems Considerations  Daniel C. Hickson		477
29	Designing Financial Policies to Deal with Limited Financial Resources  James M. Lyneis		485
30	Industrial Dynamics Model of Weekly Stock Prices: A Case Study Toshiro Shimada		503
	System Dynamics and Corporate Long Range Strategic Planning Kenneth P. Veit		533
<b>Part S</b> 32	Introduction of Minorities into Management  Alan L. Frohman, Henry Morgan, and Alexander L. Pugh III	Ţ	<b>545</b> 549
33	A Regional Economic Simulation Model for Urban Transportation Planning David E. Boyce and Seymour E. Goldstone		561
34	Narcotics and the Community: A System Simulation Gilbert Levin, Gary B. Hirsch, and Edward B. Roberts		577
35	System Simulation of Student Performance in the Elementary Classroom  Nancy H. Roberts		597
* 36	Simulation of Natural Resource Management and Sociological Systems  William T. Newell		617
Appen	dix A: Equations for the Production-Distribution  Model  Edward B. Roberts, editor	,	627
Appen	dix B: Equations for the Precision Case Ole C. Nord	(	635
Append	dix C: Equations for the Everdry Case  Edward B. Roberts	6	655
Append	Firm Model		559
Index	Edward B. Roberts, Dan I. Abrams, and Henry B. Weit		565
			1111